

Prevalence of Sleep Disturbance and Grades of Neurocognitive Dysfunction due to Prolonged Screen Exposure in Students: A Cross-Sectional Study

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Abstract

Background: Prolonged use of smartphones, laptops, tablets and other digital devices is common among students. Sleep disturbance and changes in cognitive performance may occur in the context of prolonged screen exposure.

Aim: To assess the prevalence of sleep disturbance and grades of neurocognitive dysfunction associated with prolonged digital screen exposure among students aged 18–25 years.

Methods: A cross-sectional study was conducted among 122 students in Jalgaon district. Participants were assessed using the Pittsburgh Sleep Quality Index (PSQI) and Montreal Cognitive Assessment (MoCA). Data were entered in Microsoft Excel and analysed using IBM SPSS Statistics version 26.0. Descriptive statistics were used for demographic and categorical variables. Spearman's rank correlation was used to examine the relationship between PSQI and MoCA scores.

Results: The mean age was 21.77 ± 1.62 years. The largest screen-time category was 6–8 hours/day (35.25%). The mean PSQI score was 7.17 ± 3.13; 68.85% had mild sleep disturbance, 16.39% moderate sleep disturbance, 0.82% severe sleep disturbance and 13.93% good sleep quality. The mean MoCA score was 23.78 ± 2.19; 77.05% were classified as mild impairment and 22.95% as normal, with no participants classified as moderate or severe. A statistically significant negative correlation was found between PSQI and MoCA scores ($\rho = -0.28$, $p = 0.002$).

Conclusion: In this sample, sleep disturbance and mild cognitive impairment were common. Higher PSQI scores were significantly associated with lower MoCA scores. Because the study was cross-sectional, these findings describe associations and do not establish causation.

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Keywords: screen exposure, sleep disturbance, PSQI, neurocognitive function, MoCA, students, cross-sectional study

1. Introduction

In the modern digital era, electronic devices such as smartphones, tablets, laptops, and computers have become integral to daily life, particularly among university students.[1] These devices are essential tools for learning, communication, entertainment, and social interaction. With the increasing reliance on technology, students spend several hours daily engaging with digital screens, making them susceptible to a range of physiological and cognitive consequences. Excessive and prolonged screen exposure has been identified as a growing public health concern, with sleep disturbances and neurocognitive dysfunctions emerging as significant issues among young adults. [2]

Sleep plays a vital role in maintaining overall health, emotional stability, and cognitive performance. [3] University students are particularly vulnerable to sleep problems due to irregular schedules, academic pressure, and lifestyle changes. [4]

Neurocognitive dysfunction refers to impairments in higher-order cognitive abilities, including attention, memory, executive functions, processing speed, and decision-making. [8]

These dysfunctions can be graded according to severity:
Mild dysfunction - may involve subtle deficits in attention, working memory, or processing speed, which are often not easily noticeable but may affect academic efficiency. [9]
Moderate dysfunction- may manifest as noticeable difficulties in planning, problem-solving, decision-making, or multitasking, leading to decreased academic performance. [10]

Severe dysfunction- may involves significant cognitive impairments that affect daily functioning, learning, and social interactions. [11]
Prolonged screen exposure may contribute to graded neurocognitive dysfunction through mechanisms involving sleep disruption, cognitive overload, and digital fatigue. [12] Students with higher daily screen time are likely to exhibit more pronounced cognitive impairments and decreased academic motivation. [14]
College students represent a vulnerable population due to high academic demands, social transitions, and increased digital engagement. [15] The shift to online learning, particularly after the COVID-19 pandemic, has further increased reliance on digital devices for coursework, assignments, and social interaction. [1] While technology facilitates learning and communication, overuse—especially during the evening—may contribute to graded cognitive impairments and sleep disturbances. [2] Students who engage in prolonged screen exposure are expected to demonstrate higher prevalence of sleep problems and varying grades of neurocognitive dysfunction. Mild impairments may manifest as lapses in attention and memory, moderate impairments may affect problem-solving and decision-making abilities, and severe impairments may significantly hinder academic performance and daily functioning. [3]
Despite widespread recognition of the potential cognitive and sleep-related consequences of digital screen use, limited research has investigated the prevalence of sleep disturbance and the graded distribution of neurocognitive dysfunction among university students. [4] Understanding this relationship is essential for identifying students at risk of cognitive decline, designing interventions to improve sleep quality and cognitive resilience, and promoting healthy digital habits to support academic performance and mental well-being. [5]

2. Aim and Objectives

2.1. Aim

To see the prevalence of sleep disturbance and grades of neurocognitive dysfunction associated with prolonged digital screen exposure among 18–25-year-old students.

2.2. Objectives

1. To determine the prevalence of sleep disturbances among students exposed to prolonged digital screens.
2. To assess the grade of neurocognitive dysfunction associated with varying levels of screen exposure.

3. Materials and Methods

3.1. Study Design

Cross-sectional study.

3.2. Study Setting and Duration

The study was conducted in Jalgaon district over a duration of 6 months.

3.3. Participants and Sample Size

The target population was students aged 18–25 years with digital screen exposure. A sample of 122 participants was included. The project reports a minimum sample-size calculation based on population proportion, with $p = 0.28$, $q = 0.72$, 95% confidence level, $Z = 1.96$ and absolute precision $d = 0.08$, giving $n = 122$.

3.4. Sampling

Simple random sampling was reported.

3.5. Inclusion Criteria

- Age 18–25 years.
- Participants using digital devices for more than 4 hours/day.
- Both male and female participants.
- Students willing to participate.

3.6. Exclusion Criteria

- Students with neurological symptoms.
- Students with visual or hearing impairments.
- Sleep disorders unrelated to screen exposure.

3.7. Outcome Measures

- Pittsburgh Sleep Quality Index (PSQI): The PSQI is a self-report measure of sleep quality over the previous month. The project describes 19 items grouped into seven components, with a global score from 0–21; higher scores indicate poorer sleep quality. A global score greater than 5 was used in the project to distinguish poor from good sleepers.
- Montreal Cognitive Assessment (MoCA): The MoCA is a cognitive screening tool assessing multiple domains including attention, concentration, executive function, memory, language, visuospatial ability, abstraction, calculation and orientation. The total score is 30, with higher scores indicating better cognitive performance. The project states that one additional point is added for individuals with 12 or fewer years of education.

3.8. Procedure

- Ethical approval was to be obtained from the Institutional Ethical Committee of Dr. Ulhas Patil College of Physiotherapy, Jalgaon.
- Eligible students were recruited according to the selection criteria.
- Written informed consent was obtained after explaining the study.
- Demographic information and digital-device use were recorded.
- Sleep quality was assessed using the PSQI.
- Cognitive function was assessed using the MoCA.
- PSQI and MoCA scores and demographic information were collected for analysis.

3.9. Statistical Analysis

Data from 122 participants were entered into Microsoft Excel and analysed using IBM SPSS Statistics version 26.0. Continuous variables including age, PSQI score and MoCA score were expressed as mean ± standard deviation. Categorical variables were expressed as frequency and percentage. Spearman's rank correlation was used to examine the relationship between PSQI and MoCA scores. Statistical significance was set at $p < 0.05$.

4. Results

4.1. Age-Wise Distribution

Table 1

Sr. No.	Variable	Groups	Frequency	Percentage
1	Age (in years)	18-19	10	8.20
		20-21	45	36.89
		22-23	50	40.98
		24-25	17	13.93

Age	Mean	SD
	21.77	1.62

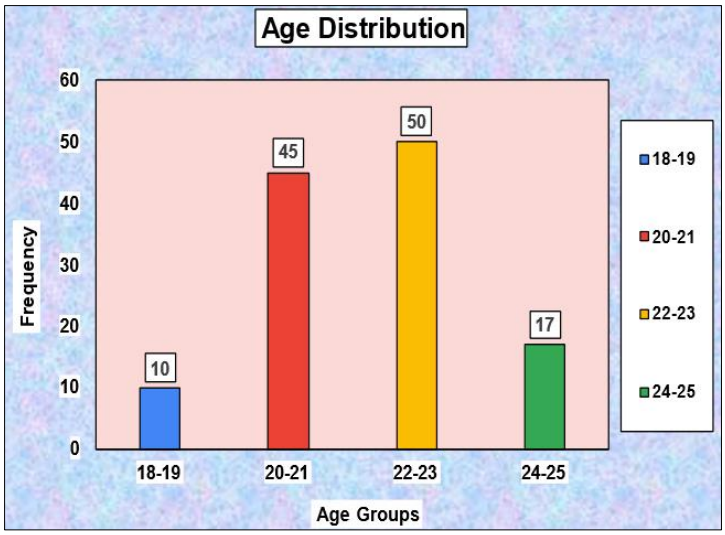


Fig 1

Interpretation: From total 122 participants, 10 were between age 18 to 19, 45 were between age 20 to 21, 50 were between age 22 to 23, 17 were between age 24 to 25.

4.2. Gender-Wise Distribution

Table 2

+Sr. No.	Variable	Groups	Frequency	Percentage
2	Gender	Male	55	45.08
		Female	67	54.92

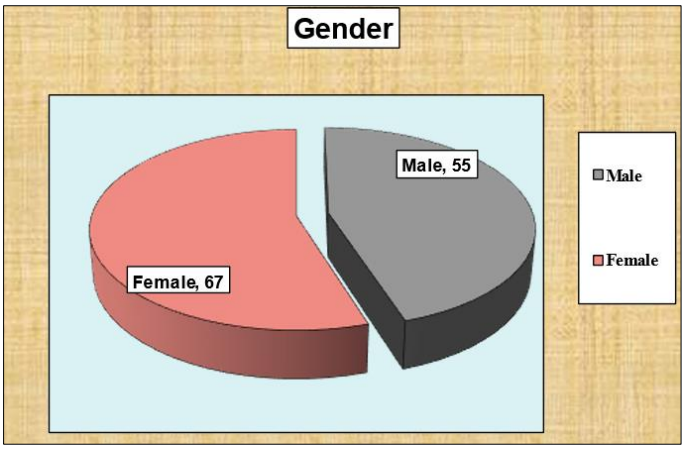


Fig 2

Interpretation: In this study, from total 122 participants, 55 were males with (45.08%) and 67 were females with (54.92%).

4.3. Daily Screen-Time Distribution

Table 3

Sr. No.	Variable	Scores	Frequency	Percentage
3	Screen Time (in Hours)	< 4	14	11.48
		4-6	40	32.79
		6-8	43	35.25
		> 8	25	20.49

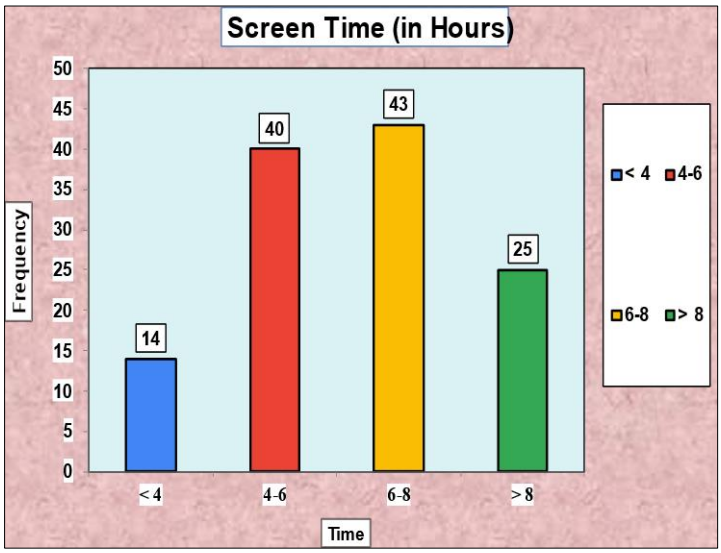


Fig 3

Interpretation: In this study, the majority of participants 35.25% reported 6–8 hours of daily screen exposure, followed by 32.79% reporting 4–6 hours, 20.49% reporting more than 8 hours, and 11.48% reporting ≤ 4 hours.

4.4. Academic Stream Distribution

Table 4

Sr. No.	Variable	Scores	Frequency	Percentage
4	Academic Stream	BHMS	22	18.03
		BPTH	23	18.85
		BSc Nursing	25	20.49
		MBBS	21	17.21
		Other	31	25.41

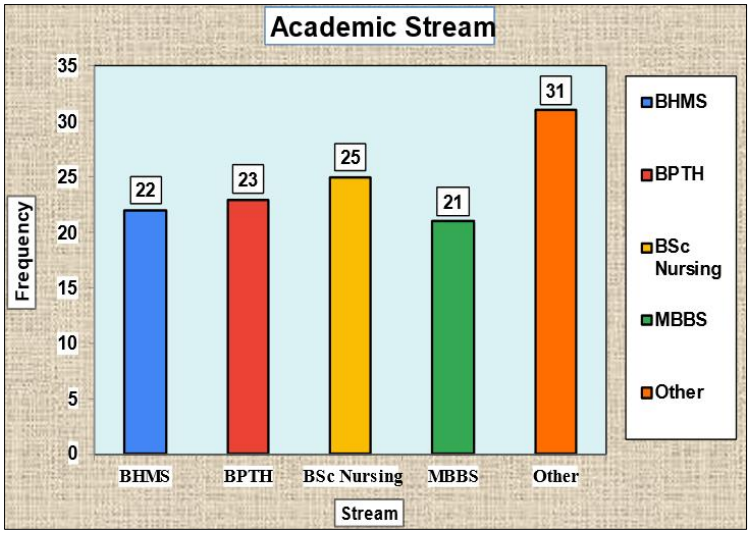


Fig 4

Interpretation: The study included students from BHMS, BPTH, B.Sc. Nursing, MBBS, and other academic programs, ensuring representation from different healthcare discipline.

4.5. PSQI Distribution

Table 5

Variable	Scores	Groups	Frequency	Percentage
PSQI	0-4	Good Sleep Quality	17	13.93
	5-10	Mild Sleep Disturbance	84	68.85
	11-15	Moderate Sleep Disturbance	20	16.39
	16-21	Severe Sleep Disturbance	1	0.82

PSQI	Mean	SD
	7.17	3.13

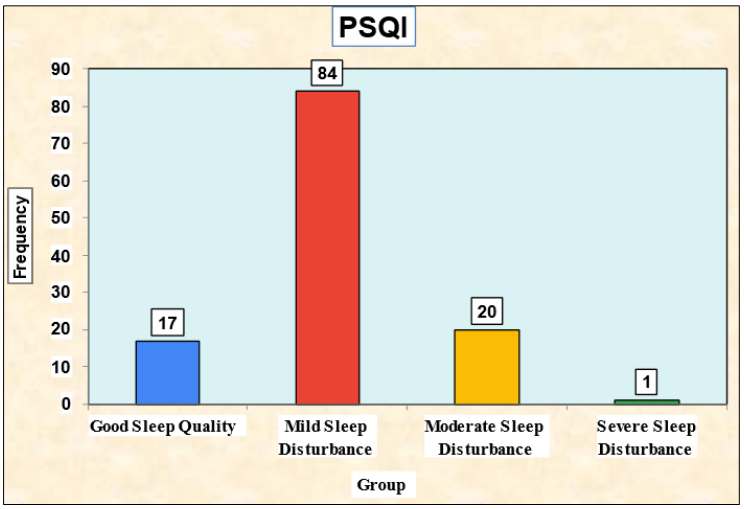


Fig 5

Interpretation: The majority of participants (68.85%) had mild sleep disturbance, followed by moderate sleep disturbance (16.39%), good sleep quality (13.93%), and severe sleep disturbance (0.82%).

4.6. MOCA Distribution

Table 6

Variable	Scores	Groups	Frequency	Percentage
MoCA (Neuro cognitive function)	26-30	Normal	28	22.95
	18-25	Mild	94	77.05
	10-17	Moderate	0	0.00
	<10	Severe	0	0.00

MoCA	Mean	SD
	23.78	2.19

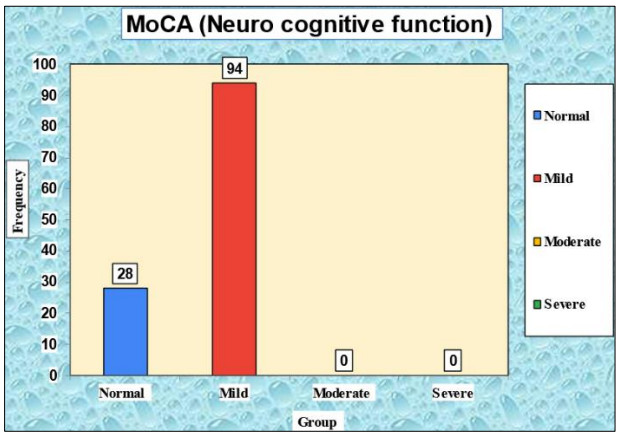


Fig 6

Interpretation: Most participants (77.05%) demonstrated mild cognitive impairment, while 22.95% had normal cognitive function. No participants exhibited moderate or severe cognitive impairment.

4.7. Correlation between PSQI and MoCA

Table 7

Correlation	p value
-0.28	0.002

*p value less than 0.05, shows the significant correlation.

Interpretation: The Spearman's Rank correlation was used to find the correlation between PSQI and MoCA. The correlation coefficient between PSQI and MoCA was -0.28 with the p value 0.002. The p value less than 0.05, shows the significant correlation between PSQI and MoCA. The scatter diagram, also confirms correlation between PSQI and MoCA.

5. Discussion

The present cross-sectional study was conducted among 122 university students to determine the prevalence of sleep disturbance and grades of neurocognitive dysfunction associated with prolonged digital screen exposure. The findings indicate that prolonged screen exposure is common among university students and is accompanied by a high prevalence of sleep disturbance and mild neurocognitive impairment. These findings are consistent with recent evidence indicating that excessive digital screen use adversely affects sleep, cognitive function, and mental health among young adults. [1-3]

- The mean age of the participants was 21.77 ± 1.62 years, with the majority belonging to the 22–23-year age group. Female participants (54.92%) slightly outnumbered male participants (45.08%), indicating that both genders were well represented in the study. This demographic profile is comparable to previous studies conducted among university students, including the study by Kaewpradit *et al*., which also included a predominantly young adult population with frequent digital device use. [3]
- Regarding daily screen exposure, most participants (35.25%) reported using digital screens for 6–8 hours per day, while 20.49% reported more than 8 hours of screen time. This finding reflects the increasing dependence of university students on smartphones, laptops, and other digital devices for academic work, social networking, entertainment, and communication. The widespread integration of digital technology into students' daily lives may contribute to prolonged screen exposure, particularly during evening hours. Similar findings were reported by Kaewpradit *et al*., who observed a high prevalence of excessive digital screen use among university students and emphasized that academic requirements, social media engagement, and entertainment were major contributors to prolonged screen exposure. [3]
- Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI). The mean PSQI score was 7.17 ± 3.13, and 68.85% of participants demonstrated mild sleep disturbance. Moderate sleep disturbance was observed in 16.39% of participants, whereas only 13.93% had good sleep quality. These findings suggest that poor sleep quality is common among university students with prolonged digital screen exposure. Extended screen use, particularly during the evening, may delay sleep onset, reduce sleep duration, and negatively affect overall sleep quality.
- Excessive screen use, especially before bedtime, may delay sleep onset, suppress melatonin secretion due to blue light exposure, shorten sleep duration, and impair overall sleep quality. These findings are comparable to those reported by Kaewpradit *et al*., who found that excessive digital screen time was significantly associated with poor sleep quality among university students. [3] Likewise, Nagata *et al*. reported that greater screen time was associated with poorer mental health outcomes, which may indirectly contribute to poor sleep quality. [2]
- Neurocognitive function was evaluated using the Montreal Cognitive Assessment (MoCA). The mean MoCA score was 23.78 ± 2.19, and 77.05% of participants showed mild cognitive impairment, while 22.95% had normal cognitive function. Although no participant demonstrated moderate or severe cognitive impairment, the high proportion with mild impairment suggests that prolonged screen exposure may be associated with subtle changes in cognitive performance, including attention, memory, and executive functioning. These findings are consistent with those reported by Shalash *et al*., who found that increased nighttime screen time was significantly associated with poorer cognitive function among healthy young adults. [1]
- The relationship between sleep quality and neurocognitive function was further examined using Spearman's Rank Correlation. A significant negative correlation was found between PSQI and MoCA scores, with a correlation coefficient of −0.28 and a p-value of 0.002. Since the p-value was less than 0.05, the correlation was statistically significant. The negative correlation indicates that higher PSQI scores, representing poorer sleep quality, were associated with lower MoCA scores, representing poorer neurocognitive performance. Although the correlation was statistically significant, its magnitude was relatively weak, suggesting that sleep quality may be one of several factors influencing neurocognitive performance.
- The scatter diagram also demonstrated a general negative trend between PSQI and MoCA scores, which was consistent with the Spearman correlation result. Participants with relatively lower PSQI scores generally showed higher MoCA scores, whereas higher PSQI scores tended to be associated with lower MoCA scores. This finding suggests that disturbed sleep may be related to reduced cognitive performance among university students.
- Overall, the findings of the present study indicate that prolonged daily digital screen exposure is associated with poor sleep quality and mild neurocognitive dysfunction among university students. These findings are consistent with previous studies demonstrating that excessive digital screen use may negatively influence sleep quality, cognitive function, and overall well-being among young adults. [1-3] As digital device use continues to increase, strategies such as limiting recreational screen time, reducing device use before bedtime, maintaining

good sleep hygiene, and promoting awareness regarding healthy digital habits may help improve sleep quality and cognitive performance. [1]
- Further multicentre studies with larger sample sizes and longitudinal follow-up are recommended to better understand the long-term relationship between prolonged screen exposure, sleep quality, and neurocognitive function.

6. Conclusion

This cross-sectional study assessed the prevalence of sleep disturbance and neurocognitive dysfunction associated with prolonged digital screen exposure among 122 university students. The findings showed that prolonged screen time was common, with most participants reporting 6–8 hours of daily screen use. Most of the students experienced mild sleep disturbance and mild neurocognitive impairment. A significant negative correlation was found between PSQI and MoCA scores ($\rho = -0.28$, $p = 0.002$), indicating that poorer sleep quality was associated with lower neurocognitive performance. Therefore, maintaining good sleep quality and adopting healthy screen-use habits may be important for students' cognitive functioning and overall well-being.

7. Limitations

- The sample consisted of 122 university students, which may limit generalizability.
- Screen-time data were self-reported and may be affected by recall or reporting bias.
- Potential factors such as stress, anxiety, caffeine intake, physical activity, medication use and medical conditions were not assessed.
- The study was conducted in a single setting/district, limiting applicability to other populations.

Future Scope

- Larger studies may improve generalizability.
- Multicentre studies involving different universities and regions may provide broader evidence.
- Future research may assess stress, anxiety, depression, physical activity, caffeine intake and academic workload.
- Interventional studies may evaluate screen-time reduction, digital-wellness education and sleep-hygiene interventions.

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Disclosure Statement

The authors declare that there are no conflicts of interest related to this study.

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Ethics Statement

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